Space Weather Technical Forecast

Issued on Sunday, 10 April 2022 at 13:33 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Likely G1/Minor Storm, Chance of G2/Moderate Storm and Slight Chance of G3/Strong Storm on Day 1 (10 Apr). Chance of G1/Minor or G2/Moderate Storm day 4. Chance of Active fluence on Days 2 and 3 (11-12 Apr).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with two C-flares from AR2978. There is now one sunspot region on the Earth-facing disc, as AR2978 and AR2981 have both rotated off the southwest limb. The remaining region is small and simple. A large filament in the southwest of the disc lifted off on 9th Apr. The associated CME has been analysed, with the bulk of the ejecta travelling below Earth's orbit, but looks like it may have an Earth directed component.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was indicative of weak CME effects and a HSS arrival through the overnight period UTC. Wind speeds were initially slow-ambient, gradually rising to elevated by 10/0900 UTC, with a maximum of 520 km/s, before settling back to slightly elevated levels by the end of the period. The density fluctuated between above average and average levels throughout peaking several times between 30-40 ppcc. The interplanetary magnetic field (IMF) strength, Bt, was Weak initially before soon becoming Moderate, with a Strong interval between 09/2300-10/0400 UTC. The north-south component, Bz, ranged between +15/-15 nT, with the most notable switch to southward direction between 10/0200-0900 UTC. The Phi angle also made a notable switch from positive (away from the Sun) to negative (towards the Sun) shortly after 10/0200 UTC. Geomagnetic activity was largely Quiet to Active (Kp 0-4) with two Moderate Geomagnetic Storm intervals (Kp 6) between 0300-0900 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at background levels. The high energy (greater than 2MeV) electron flux was mostly at normal background, with brief spells at moderate levels. The corresponding 24-hour fluence was on a slight increasing trend, with 5.24e6 integrated pfu observed at 10/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low or Very Low, with only one small and simple sunspot on the disc. There is a Chance for further C-class flares during Day 1 (10 Apr), which will decline as AR2978 rotates further away from the southwest limb.

Solar Wind / Geomagnetic Activity: Current HSS effects from CH72/73/- may be enhanced by a CME arrival during Day 1 (10 Apr). Timing of this feature is uncertain, but combined CME and HSS effects are expected to dominate during Day 1, slowly starting to ease during Days 2 and 3 (11-12 Apr). A further CME is possible late on Day 3 or early Day 4 (12/13 Apr) originating from a filament eruption on 09 Apr.

Geomagnetic activity is forecast to be Quiet to Active with G1/Minor Storms likely, a chance of further G2/Moderate Storms and a slight chance of G3/Strong Storm intervals later in Day 1. The

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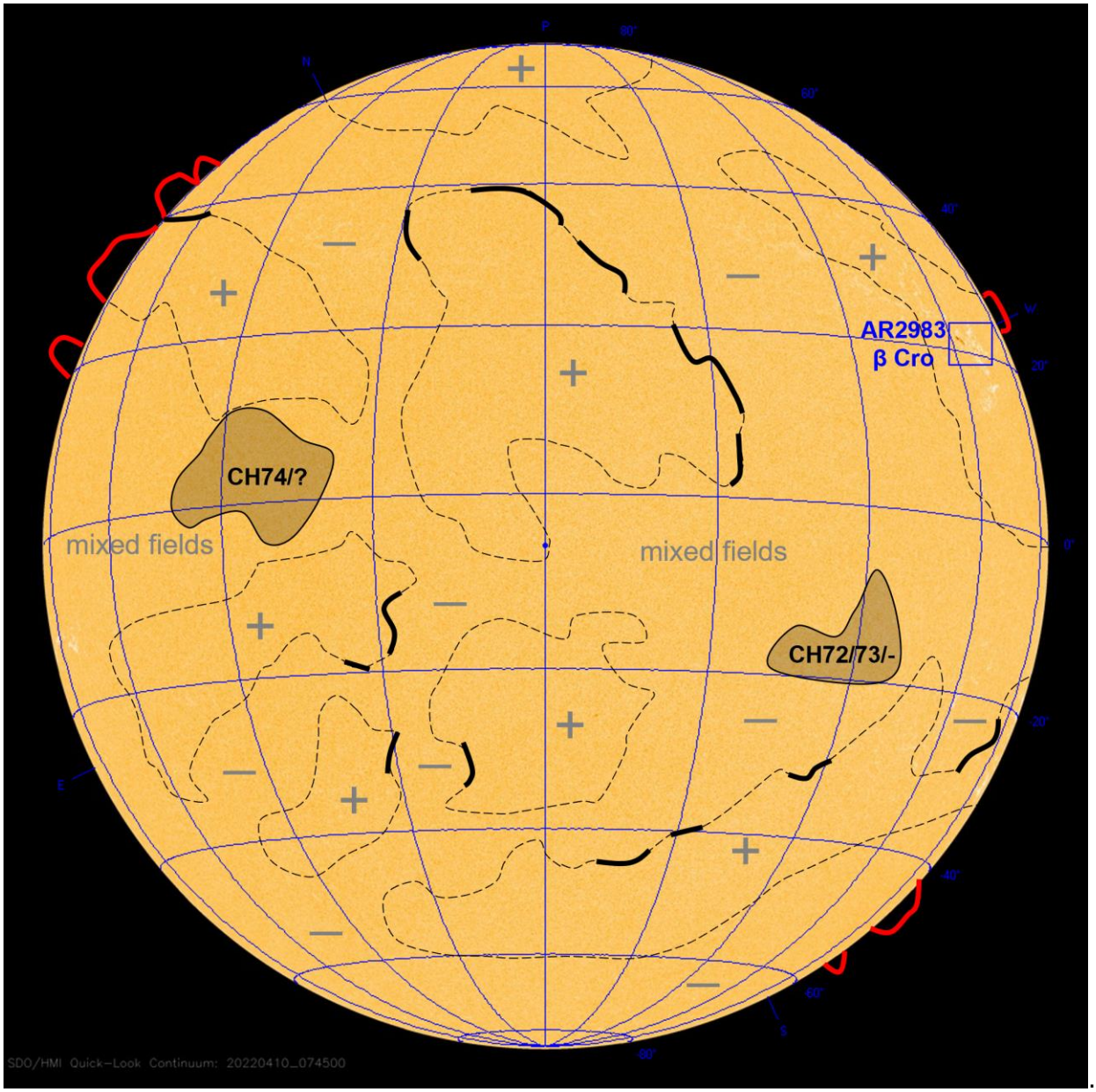
risk of G1 will gradually decline through Days 2 and 3, before increasing again later on Day 3 or early Day 4 with a further possible CME arrival.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels. The high energy (greater than 2 MeV) electron flux is forecast to start at background levels, perhaps rising to peak at High levels on Days 2 and 3 (11-12 Apr), before a further CME arrival is likely to suppress levels once again. The associated 24 hour fluence is likely to remain below the Active threshold but with a chance of rising above on Days 2 and 3.

Figure 1. Solar Analysis Valid 10/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Current HSS effects from CH72/73/- may be enhanced by a CME arrival later in Day 1 (10 Apr). Timing of this feature is uncertain, but combined CME and HSS effects are expected to dominate during the remainder of Day 1, slowly starting to ease during Days 2 and 3 (11-12 Apr).

A further CME originating from a filament eruption on 09 Apr is expected to have an earth directed component. This CME was largely southward directed, but there appears to be some ejecta earthbound on LASCO C2/C3 imagery, and ENLIL has computed a glancing blow. The arrival is currently modelled to be late on Day 3 (12 Apr) or early Day 4 (13 Apr).

Geomagnetic activity is forecast to be Quiet to Active with G1/Minor Storms likely and a chance of further G2/Moderate Storms later in Day 1. There remains a Slight Chance of G3/Strong storms due to current wind speeds and recent events. The risk of geomagnetic storms will gradually decline through Days 2 and 3, before increasing again later on Day 3 or early Day 4 with the further possible CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	70	40	40	60
Strong	G3	No	10	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/1317	Partial	Filament	SE	416	09/2100	Possible G2
09/2010	Partial	Filament	SW	500	13/0100	Glancing blow possible.

Figure 2: Enlil at 2200 on 12th showing glancing blow soon arriving from southward directed CME.

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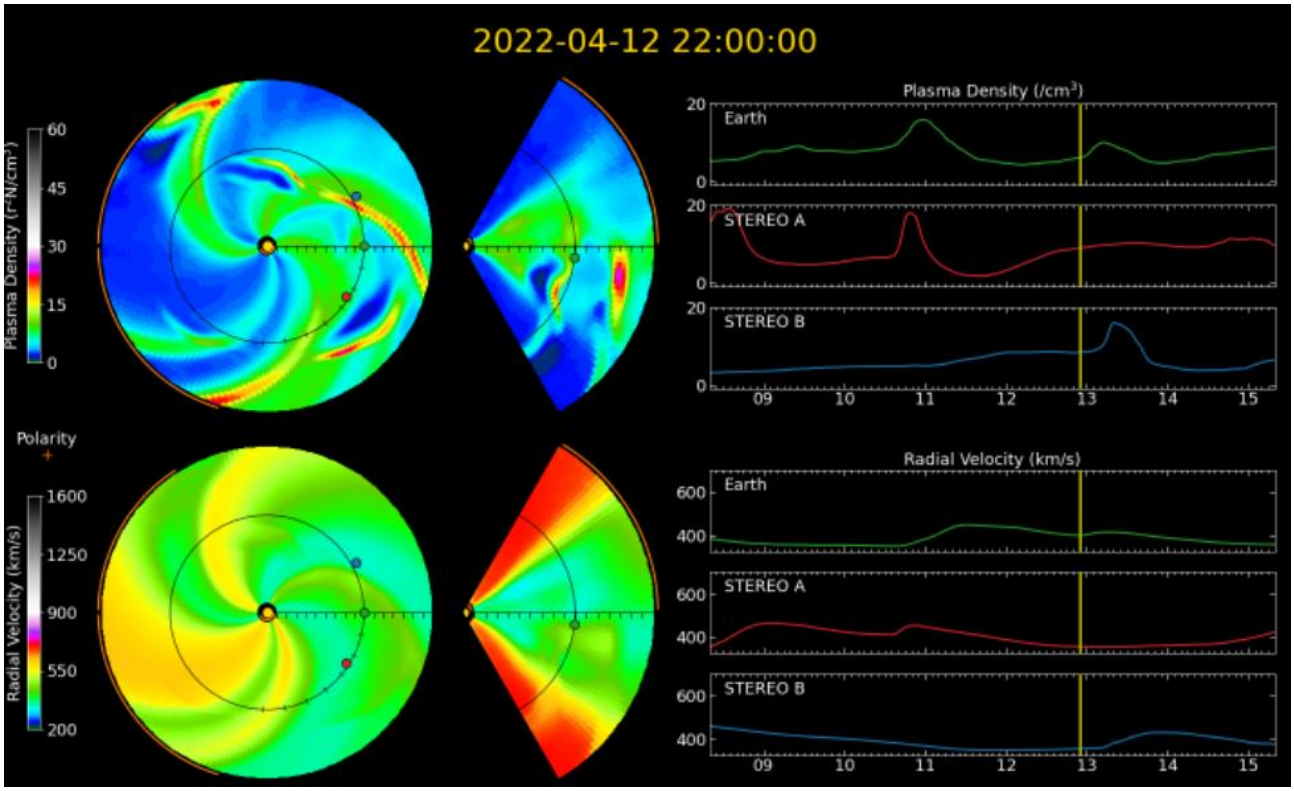

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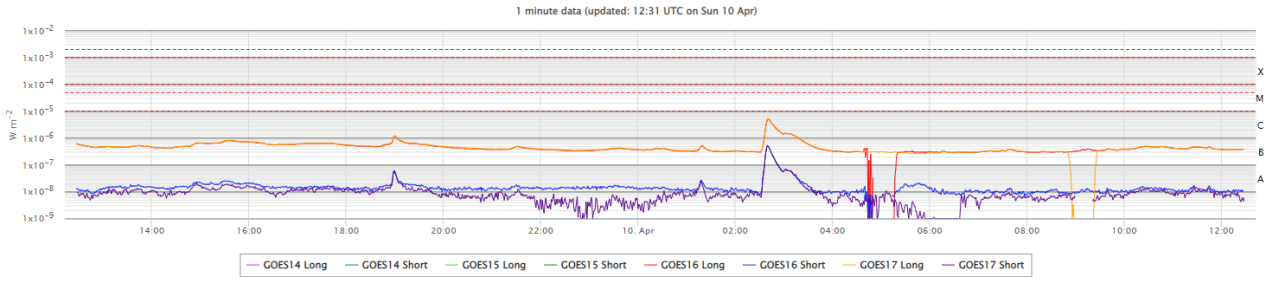
Radio Blackouts - X-Ray Flares:

There is now one sunspot region on the Earth-facing disc, this relatively simple and inactive. C-class activity in the past 24 hours has mainly came from AR2978 which has now rotated over the southwest limb, along with AR2981. AR2978 will, however, contribute to the flare probability until it is well over the limb. The remaining region is AR2983 (Cro/Beta) which is small and simple with low flare risks.

Overall, activity has been Low, with two C-flares from AR2978. Low activity is expected to become Very Low as AR2978 rotates further off the disc. One further possible region may rotate onto the southeast limb in the coming days, but it doesn't currently look particularly active in STEREO-A imagery.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	2	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Xray trace past 24 hours.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background and in the absence of complex sunspots on the Earth-facing disc is expected to remain at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

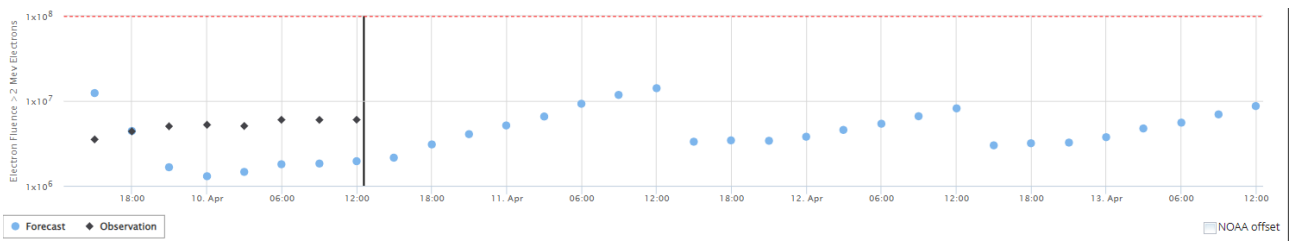
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV), as observed by GOES-16 at GEO, has been mainly at normal background or moderate levels through the last 24 hours. Recent CME arrivals and a likely HSS arrival is expected to keep flux levels suppressed at first, before a possible rise through Days 2 and 3 (11-12 Apr) in response to the HSS. Flux may peak at High levels during this time, before a further possible CME arrival late on Day or early Day 4 (12/13 Apr) may suppress flux levels once again.

The associated 24 hour fluence is below the Active (1e8 integrated pfu) threshold and is likely to remain below through the forecast period, although a rising trend is possible on Days 2 and 3. A decline is then likely on Day 4 in response to possible CME effects. REFM will not be taking account of CME effects, or the HSS as this is a non-recurrent feature, and as such is unlikely to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	20	30	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: REFM integrated flux/fluence forecats and observations.



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